

and very densely punctate, the punctures in series, and the alternate interstices elevated, so as to form very fine, rather in distinct costæ, and sparingly clothed with erect, rather coarse, very short, pale setæ.

A good series was secured, in the same tree as *Cautomus hystriculus*, near Nagasaki, 25th March, 1881.

DESCRIPTION OF PLATE III.

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| Fig. 1. <i>Neotrichus hispidus</i> , Sharp. | Fig. 7. <i>Teredolæmus politus</i> , Lewis. |
| 2. <i>Synpanotus pictus</i> , Sharp. | 8. <i>Erotylathris costatus</i> , Sharp. |
| 3. <i>Labromimus variegatus</i> , Sharp. | 9. <i>Dastarcus longulus</i> , Sharp. |
| 4. <i>Ithris sculpturata</i> , Sharp. | 10. <i>Cautomus hystriculus</i> , Sharp. |
| 5. <i>Gempylodes Lewisi</i> , Sharp. | 11. <i>Thyroderus porcatus</i> , Sharp. |
| 6. <i>Cylindromicrus gracilis</i> , Sharp. | |

Notes on the Antennæ of the Honey-Bee. By T. J. BRIANT.
(Communicated by B. DAYDON JACKSON, Sec. Lin. Soc.)

[Read 15th November, 1883.]

THE antennæ of the Honey-Bee (worker) are inserted quite close together, immediately above the upper margin of the clypeus (fig. 1). They consist of a pair of jointed cylindrical organs of two distinct parts, called respectively the scape and the flagellum. The scape is united to the cranium by a hemispherical cup, to which it is joined by a short constricted peduncle (fig. 2 *a*). At its anterior end it is united to the flagellum, and is normally at right angles to it.

The antenna moves as a whole upon a point or fulcrum formed by the interlocking of the peg or process (*a* in fig. 3) with the notch in the cup (*b* in fig. 2). This process arises on the inner or medial side of an arch which bridges over the antennary fossa to near its top on the outer edge, and the process is thus nearly in the centre of the fossa. The movements of the antenna are controlled by three muscles:—(1) a muscle inserted into the outer margin of the basal cup, which moves it outwards (figs. 3 & 4, *b*); (2) a muscle inserted into the upper and inner margin, which moves it upwards and inwards (*c*); and (3) a muscle inserted in the lower margin, which opposes the other muscles and lowers the antenna (*d*). These muscles arise from the internal skeletal parts of the cranium, which cannot conveniently be described without entering into details of the endocranium.

The scape is rather less than half the length of the flagellum. The larger portion, or shaft, has its anterior end cut off obliquely and so allows of the flagellum bending upon it by a simple motion of flexion and extension. These motions are produced, one by a muscle arising from the lower inner wall, and inserted into the lower side of the second segment of the antenna (fig. 2 *d*); the other by a muscle arising from the upper inner wall, and inserted into the upper side of the same segment (fig. 2 *e*).

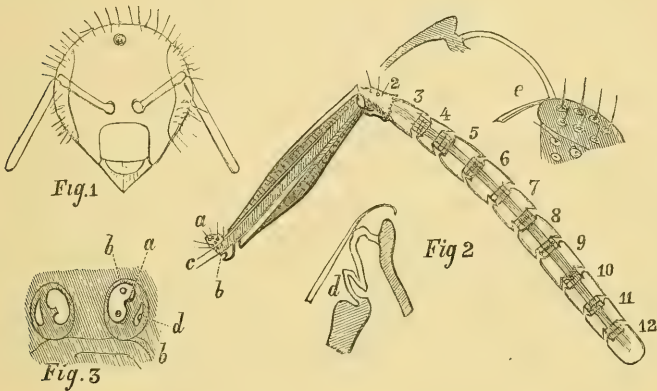


Fig. 1. Outline of head of Bee, showing position of antennæ.

Fig. 2. Sectional view of antenna; with enlargements of upper and under part of the articulation to show the insertion of the muscles *e* and *d*; *c*, nerve.

Fig. 3. The antennary fossæ from below. The dots *b* and *d* show position of insertion of muscle; *a* is the peg or process upon which the antenna moves.

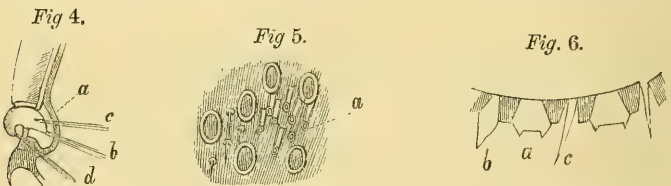
The segments forming the flagellum are alike in form and vary but slightly in size, the most distant one (the 12th of the antenna) being twice, and the fifth being about $2\frac{1}{2}$ times longer than broad. The fourth is peculiarly short, not being more than two thirds of its breadth, and moreover tapers somewhat towards its posterior end. The third continues the tapering, but in length is twice its mean breadth. The second is slightly bent, and bears on each side the swelling or knob upon which the flagellum hinges with the scape.

The joints connecting together the segments numbered in fig. 2 as 4 to 12 are all very similar in plan, and consist essentially of a convexity on the posterior end of one segment fitting into the concavity of the anterior end of the preceding segment.

The ends are as it were pierced with a hole of comparatively considerable size, and the edge of each hole is bent inwards. A band of elastic tissue runs from the inner edge of the bent-in part of one hole to the inner edge of the bent-in part of the other, and thus connects the parts together by a joint which, while allowing of movement in every direction, yet does not in any way compress the tube. The segments 2 and 3 do not appear to be moveable upon one another.

I do not find any muscles regulating the movements of these segments; nor can I discover, from anything I have at present seen, that the Bee ever voluntarily moves them upon one another.

The offices these organs fill in the economy of bee-life, evidently all-important to the Bee, is a matter of much mystery; it seems to be scarcely a matter of dispute, for no one appears to have settled the question to his own satisfaction; but a close examination of the flagellum discloses certain hairs and pits, found chiefly on the front of the antenna, which must be accounted for in any theory which may be put forward. They were noticed for the first time by Dr. J. Braxton Hicks; and his communications are to be found in vol. xxii. of the 'Transactions of the Linnean Society,' pp. 148 and 388. He seems, however, to have confined his attention to the markings appearing on segments in the middle of the flagellum.



- Fig. 4. Sectional view of the articulation of antenna: *a*, bridge; *b*, *c*, and *d* indicate the position of the insertion of the muscles.
- Fig. 5. Part of a segment of antenna near the end, showing oval markings; *a*, the group of openings leading to the tubular structure shown in fig. 8, *a*.
- Fig. 6. Diagrammatic section of the structure shown in fig. 5.

The cup at the base of the scape is furnished with hairs which spring apparently from the bottom of pits, and radiate in all directions. Similar hairs are also to be found on the second segment. From not finding any nerve-structure intimately connected with these hairs, and also from finding hairs of a similar description in some parts of the sting, I conjecture that their office is merely mechanical, and that they serve to keep the

joint in its proper place. The membrane which joins the scape with the second segment has some very minute yellow dots upon it, which terminate in short sharp points or hairs. The markings on other segments are described by Dr. Hicks in these words:—"Every structure consists (viewed from above) of round transparent spots about $\frac{1}{1760}$ inch in diameter, but on a side view they are seen to be depressions of the surface, the internal wall being perforated, with a thin membrane closing in the perforation, which is probably the external layer of the antennal wall continued over it." This is quite accurate as regards those segments in the middle portion of the flagellum, but as they approach the anterior end, and especially in the last segment, they are much more complicated. On the end segment there seem to be five distinct sorts of structures.

The first, when viewed from above, appear as openings in the wall of the antenna, which, on a broken edge, are seen to be covered by a membrane. Upon focusing down to the general surface of the antenna, this suddenly opens into a wider space surrounded by a ring of dark dots; and on continuing the focusing, the opening again contracts to a size smaller than the opening on the outer wall. If, however, a fresh antenna be examined, under a $\frac{1}{2}$ -inch object-glass, without any preparation and with light directed along it from the anterior end, the structure appears as in fig. 5 (sectional view *a*, fig. 6). The upper membrane is supported upon a rim, and presents somewhat the appearance of the lid of an oval hunting-watch, the small glass representing the upper membrane.

The second structure is found interspersed amongst those just described, and consists of smaller openings, which, instead of being closed in at the top, are drawn out into a pointed hair (*b*, fig. 6).

The third structure consists of hairs springing from the base of still smaller pits (*c*, fig. 6).

The foregoing coincide very closely with some of the structures described by Dr. Hicks in other insects, the first being similar to that of the antenna of *Andrena fulva*; but he does not give any description of its appearance by direct light. The second and third are similar to structures found by him in the antenna of *Geotrupes stercorarius*. I give a diagrammatic figure of them in section in fig. 6.

The fourth structure is found only on a ridge on the end of the last segment, fig. 7. The appearance is that of hairs sunk in pits

as before; but they are distinctly slighter in build and are bent at right angles at about half their length, the hooks of the hairs on either side being directed towards each other. It must be remembered that the Bee invariably uses this extreme tip in touching anything; and that it touches its fellow Bee upon the front of the antenna. It is also to be noticed that the wall of the antenna becomes considerably thinner at the extreme tip.

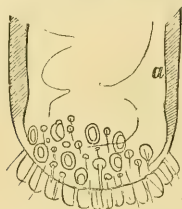


Fig. 7

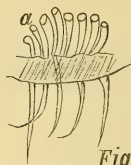


Fig. 8

Fig. 7. Section of apical segment of antenna, showing the thinning of the walls and the hooked terminal hairs: *a*, granulous nerve-structure.

Fig. 8. Section of fragment of antenna, showing, *a*, tube-like organs seen at *a*, fig. 5.

The fifth structure is more difficult to make out. Within, the segments are lined with granular nerve-structure (fig. 7, *a*); and in certain parts are to be found imbedded in this nervous matter some tubular, slightly conical forms (fig. 8, *a*), which arise from the inner surface of the antenna. They are very similar to the stethoscope-like organs described by Sir John Lubbock in the antenna of *Myrmica ruginodis**, excepting that there is no tube connecting them with the walls of the antenna, with which they are in immediate contact, and through which they communicate with the outside, by pores collected into a small group (fig. 5, *b*), and found near the articulation.

It is probable that the hooked hairs at the end of the antenna are active sense-organs, and that the other organs are passive. That some are for smell there can be no doubt; but as there remain yet to be described several organs of the same character in various parts of the tongue and mouth, it is perhaps premature to attempt to settle the special offices of those of the antenna.

P.S.—Since the above was read to the Society, I have, through the kindness of Dr. Murie, had my attention directed to a paper by Dr. Paul Schiemenz in the 'Zeitschrift für Wissenschaftliche Zoologie,' Band xxxviii. 1883, p. 71, in which he gives a description of the foregoing structures, and refers to them as touch- and smell-organs.

* 'Ants, Bees, and Wasps,' 1882, p. 227; and Monthly Micros. Journ. 1877, p. 131.